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THE SMITHSONIAN INSTITUTION, ITS FUNCTION AND ITS FUTURE[1]

ORIGIN AND PRINCIPLES OF THE SMITHSONIAN

WHAT is the Smithsonian Institution? What is its relation to the government? How was it founded and for what purpose? Above all, what does it do and what may be its significance to human welfare in the future? Is it capable of meeting the wholly different needs of science to-day with the same success which attended its earlier years? These are the questions which I propose to answer.

The institution is the interpretation of the broad interests of James Smithson, an English scientific man who, though he never saw this country, had such confidence in our then young republic that he made it the trustee of his entire fortune to be used for "the increase and diffusion of knowledge among men." His interests are most tangibly brought out by his published writings. Smithson's publications number twenty-seven and include contributions to a wide range of subjects, from the origin of the earth, the nature of the colors of vegetables and of insects, the analyses of minerals and of chemicals, to improved methods of constructing lamps and of making coffee.

Certain fundamental facts necessary to a proper understanding of the Smithsonian's past and its potentialities can be deduced from the strange story of its origin. In the first place the institution is not of national origin, as is frequently supposed, but was the establishment of an individual. In the second place it is privately endowed and privately financed. The government of the United States is merely the trustee to carry out the design of the testator, and to put this into effect has transferred the responsibilities to a board of regents or trustees. In the third place the organization has the maximum of flexibility; a minimum of individuals are permanently supported; at any time it may be so remodeled as to meet existing circumstances, permanent or temporary.

As to the institution's achievements, whatever it accomplishes must result from its adherence to the basic principles deduced from the will of its founder by its first secretary, Joseph Henry.

The first of these principles is to investigate problems of scientific promise irrespective of present eco-

[1] American Association for the Advancement of Science, General Session, Friday, January 1, 1926.

nomic value in directions which hold no immediate prospect of economic return; to undertake the investigation of field problems in this country and abroad, either by itself or in cooperation with other institutions; and to provide means of publication for worthy investigations which otherwise would have no certain prospect of reaching the scientific world, avoiding the publication of such matter as can be published through other agencies.

Since the will makes no restriction in favor of any particular kind of knowledge, a second principle permits the institution to give a share of its attention to all branches. As a result of this the Smithsonian's record includes achievements in fields so widely divergent as aviation, astrophysics and the animals of the deep sea.

Perhaps the principle that has permitted the institution to make its most effective contributions is that which forbids it to undertake any activity that is being carried on by any other organization. In other words, the policy of the institution is to insure the furthest possible advance of knowledge; to aid and encourage scientific research along lines not receiving adequate support from other sources, and not to interfere with work done under other auspices, private or governmental. The Smithsonian Institution collaborates with other scientific institutions, but strives to avoid competition with any.

ACHIEVEMENTS, PAST AND PRESENT

What has the institution done? By the frugal and efficient use of its slender resources it has demonstrated most conclusively the fundamental economic value of many lines of scientific work. Congress appropriated last year $5,618,549 for the support of bureaus, such as the Weather Bureau, the Bureau of Fisheries and the Geological Survey, which are a direct outgrowth of the early activities of the institution; which took their origin from small beginnings under its auspices. Congress now appropriates annually a sum equal to about five times the whole endowment of the institution for the running expenses of organizations either directly created by it or made possible through its researches and other activities.

Of this annual congressional appropriation $971,000 is for the support of various units still retained under the direction of the institution, which exercises supervision over them and guides their work in its broader aspects. This administrative work is merely a side issue of the Smithsonian's activities, and is carried on purely for the sake of functional efficiency.

The fact that Congress annually entrusts the supervision of the disbursement of such a sum of money to the Smithsonian is a striking testimonial of congressional confidence in the institution.

At the present time certain of these administrative children of the institution, especially the National Museum, have become so large that they have become confused with the parent organization. This has led to the very prevalent idea that the Smithsonian Institution and the National Museum are really the same thing, which is not at all the case. The National Museum is a government bureau, the Smithsonian is a private institution situated at the seat of the government under its immediate protection and, through the governmental representation on the board of regents, under its supervision, in such a way, however, as to be wholly free from the influence of politics.

If the Smithsonian has done no more than to lay the groundwork of these ten technical bureaus of the government it would have fully justified its existence.

These represent, however, only one phase of the institution's work. As typical of the wide range of concrete accomplishments I may mention Secretary Langley's work on aerodynamics, Michelson's determination of the standard meter in wave lengths, H. L. Clark's work on the apodous holothurians, Standley's exhaustive studies of the trees and shrubs of Mexico, which has already enabled one American industry to eliminate waste in the importation of raw gum from Central America, and the publication of Squier's and Davis's work on the ancient monuments of the Mississippi Valley, the first great monograph on American archeology published in this country.

NEEDS IN SCIENCE WHICH THE SMITHSONIAN PROPOSES TO MEET

Out of the Smithsonian's past and present looms its future. In the past few years the institution has been developing a broad program of fundamental research and publication on which it proposes now to enter.

A survey of the scientific field to-day shows an increasing number of lines of fundamental investigation which presumably will yield results of value, yet of which no one can confidently predict the economic outcome. Such lines of work can not well be carried on except by institutions with unusual facilities and the broadest contacts, and it is precisely these lines of investigation that the Smithsonian proposes to undertake.

STUDIES ON THE SUN

The work of the Astrophysical Observatory, begun many years ago by Secretary Langley, now gives promise of leading to results transcending in importance his achievements in the field of aeronautics, which laid the foundation for modern aviation.

Under C. G. Abbot, the observatory's measurements

of solar radiation have come to be the standard for the world, as are the instruments originated and perfected by it. As a result of the work already under way, there is a possibility amounting almost to a probability that in the near future these investigations will furnish a sound basis for the accurate determination of at least the broader features of long-range weather forecasting. You can all appreciate what such a development would mean to the navigation of the air as well as of the sea, to agriculture, to industries, to all of you here present in your individual lives, no matter what your interests or occupation.

The chief object of the work of the Astrophysical Observatory at present is to secure the most exact measurements of the variations of the sun in order to provide proper data for studying the influence of solar changes on the weather conditions of the United States and the whole world. Daily telegrams reporting the solar radiation are received from the stations in Chile and in California which arrive in Washington within twenty-four hours of the observations in the field. For the past two years daily telegrams giving the solar values have been sent from the observatory to Mr. H. H. Clayton for use in connection with his experimental forecasts for the city of New York. These usually reached him before noon on the day after the observations were made in Chile and in California. Making up his New York forecasts for three, four and five days ahead, Mr. Clayton communicated these to the observatory by letter on the same afternoon. On Friday of each week he forecast the temperature departures for the ensuing week beginning on Sunday, and about the end of each month he forecast the temperature departures for the ensuing month. These forecasts were also mailed in advance to the observatory.

These forecasts were compared with the actual weather conditions, using mathematical processes of verification not susceptible of personal bias. A moderate degree of foreknowledge is certainly indicated, both for the specific forecasts of three, four and five days in advance, and for the more general average forecasts of weeks and months. These experimental forecasts were stopped at the close of 1925 because of the lack of further financial support.

In order to eliminate so far as possible all error in the measurement of the solar constant, the institution needs a fourth observatory, in addition to those in Chile and in California, and the one for which the National Geographic Society has just provided funds in Morocco or Baluchistan.

In order to hasten our knowledge of the complex relationship between the solar variation and the weather, it is essential that meteorological data for the past one hundred years be collected, digested and published for the purpose of furnishing a basis for the determination of new principles.

The expansion of the Smithsonian's astrophysical program will include investigation of the quantity and quality of the vital ultra-violet rays emitted by the sun; the intensity of sky radiation as well as of sun radiation; the effect of the earth's atmosphere on the quantity and quality of the ultra-violet rays, and the effect of the sun's rays on food plants. For these and similar studies plans are ready.

STUDIES ON THE SEA

The second phase of the Smithsonian's program concerns investigation of the sea. There is no line of investigation in which so many different forms of science play a part as in the study of the sea, and there is no line of work that promises to yield more results of value to us.

What is known as oceanography contemplates investigation of the waves and tides and currents and of all the physical and chemical properties of water, both pure and with various substances in solution or suspension. It includes the study of the plants and animals of the sea, of the relationships between them and of the relationships of both to the physical and chemical features, fixed or variable, of the medium in which they live. It also includes the study of the erosion of the shore lines and the change in bottom contours as well as of the piling up of sediments, organic and inorganic, on the ocean bottom, and of the resulting alteration in the isostatic balance. It further covers the investigation of the evaporation from the surface of the water, and of the circulation of the air above it. Oceanographic observations are of value only if we know the exact spot where they were taken. The localities are determined by recourse to applied astronomy and to various forms of mathematics.

From the sea each year we draw an enormous quantity of food, mostly in the form of fish, shellfish, crabs and lobsters. In order to conserve these food resources and further to develop them, we must know just how these creatures live, what they feed upon, their habits and the habits of their parasites and enemies, and their relation to salinity and temperature.

As an illustration let us take the cod. The cod is our most important fish. It can exist only in cold water, and there only where its food is plentiful. It feeds mostly on bottom living scavengers, chiefly crustaceans and echinoderms. What do these feed on? They consume mostly dead organic matter which in the cold waters frequented by the cod is preserved as in an ice box. This dead organic matter is from two main sources. Uncountable billions of small

organisms in the upper layers of water are continually dying and falling to the bottom where the larger are discovered and devoured by the scavenging crustaceans, and the smaller, mixing with the bottom mud, are digested out of it by the mud-swallowing echinoderms. What feeds these billions of small organisms? The minute plants, diatoms, peridinians and others form the basic food upon which ocean life exists, with the help of sunlight forming organic out of inorganic substances. What supports these plants? Materials washed from the soil by rain and brought to the sea by rivers, gases taken from the air in cold rough weather, and the dead bodies of sensitive southern creatures brought up by the Gulf Stream and killed by cold. The other source of food for the crustaceans and echinoderms that serve as food for cod is the dead bodies, sometimes the living bodies, of the bottom living types, sea-pens and similar things among which they live. These are all fed, however, from above. Near the coast the detritus from the seaweeds on the shores, especially the eel-grass, where it occurs, is an important food, particularly for bivalve mollusks, and through them for crustaceans, echinoderms and the cod.

Thus in order properly to understand the cod, we must be familiar with the contacts of all the other creatures in the seas in which it lives; with the effect upon them of different degrees of heat or cold and the concentration of salts, wave action and varying degrees of light or darkness; with the relative food values of the substances in the bottom muds; with the amount and kind of the food material delivered by the rivers, and with many other things quite apart from the life history, migrations and other facts about the cod itself.

Certain of our sea foods, like the northeastern lobster and the oyster, are so very popular that the demand threatens the supply, and measures must be taken to protect them. But such measures as are taken are devised by inference from what we assume to be the facts in their life history and environment, and have been developed by a series of experimental measures each meeting with more or less success, whereas obviously they should be based upon a complete or at least adequate knowledge of what they feed upon and how, their relation to the bottom and the physical and chemical conditions of the water and their life cycle. We do not have a complete picture of the interrelationships of any of our marine animals or plants. The oyster is practically the only creature in our seas of which we have even a reasonable knowledge. But even with the oyster new and important facts each year are brought to light.

As on the land, all animal life at sea must depend on plant life for its existence, since only plants can form organic from inorganic compounds. Plants can do this only with the aid of sunlight. Therefore all ocean life depends wholly on conditions within the thin illuminated surface layer, nowhere more than 600 feet in depth, beneath which it is too dark for plants to grow. We know practically nothing of the conditions of illumination necessary for the growth of sea plants, or of the depth in different places or at different seasons of the illuminated upper layer of water in which alone the plants can grow.

The sea plants are of two main types, each with important subdivisions. There are the large attached algae and flowering plants, commonly known as seaweeds, along the shores, and the minute plants of microscopic size which live suspended freely in the water like suspended particles of mud or silt. We know practically nothing about the relative abundance of the different kinds of plants, their relative value as food for animals, their wastage or their fluctuations in response to varying conditions, all of which is of basic importance in understanding the potentialities of the sea as a source of animal foods.

Most people visualize the sea as more or less equally productive everywhere. This is not so. In the first place, though animal life extends downward into the abysses for at least three and three quarters miles, plant life can not exist below at most 600 feet. all the sea animals no matter how deep they live being fed by plants growing in this thin surface layer. In most places in the sea animals are most numerous and varied in the so-called twilight zone where the light is dim and not harmful to them and yet where there is enough light to support some plants. A mapping of this zone and its inhabitants along our shores would produce results of the greatest interest. Below this zone, which is the great zone of mystery wherein presumably the giant squid, huge crabs and large and grotesque fishes find their home, animal life becomes rapidly less abundant, and the animals decrease in numbers, kinds and size. In the second place, in passing from the shores out into the open sea animal life becomes less common and toward the middle of the oceans disappears. Why? Because the animals of the sea depend upon the plants which in turn depend largely, though how largely we do not know, on foodstuffs washed into the sea by rain and streams and by the action of the currents held for the most part near the shores. Of the details of this we know practically nothing.

Each year the rivers of the world carry to the sea millions of tons of mud taken from the surface of the land, and millions of tons of salts in solution in their waters. By this continuous process an enormous total weight of soil and salts is being constantly removed from the land areas. The soil, in the form of mud

and sand, is dumped upon the ocean bottom, while the dissolved salts increase the weight of ocean water both by their own added weight and by gradually diminishing the amount of evaporation from its surface, thus adding to the ocean's bulk. Much of the dissolved material brought to the sea by rivers goes to form the shells of billions of small creatures which when they die fall upon the ocean floor, covering millions of square miles of bottom.

The continuous subtraction of vast masses of material from the land and their addition to the weight of the ocean basins in which they are very unequally distributed necessitates constant or intermittent readjustments to maintain an equilibrium or condition of isostasy between the land and sea.

So far we have not attempted to appraise the effect upon us of the transference of material from our land area to the ocean basins, nor do we know the percentage of the loss in soil fertility of our farm lands which is recoverable in the bodies of the fish and other creatures caught along our shores.

As an example of an interesting bit of work along this line I might suggest the following. The Mississippi River delivers every year to the Gulf of Mexico 370 million metric tons of silt, in addition to millions of tons of salt dissolved in its water. Most of the silt, which is derived from the whole area of the Mississippi Valley and also from the mountains on each side, is dumped upon a relatively small area of sea bottom. There is a possibility that this disturbance of the equilibrium has some relation to the volcanic activity and the earthquakes which are so frequent from Mexico to Costa Rica. Similarly it is conceivable that the deposition on the sea bottom of the mud from the Orinoco and the Amazon may have some relation to the disturbances in the Antillean chain from St. Vincent to St. Kitts. In this area the study of the building up of the ocean bottom by silt from rivers and by the accumulation of the shells of animals dying in the upper layers of water can be carried on to the best advantage, for from time to time at well-known dates there have occurred terrific eruptions on the island of St. Vincent scattering dust over almost the whole area of the Caribbean Sea, which, going to the bottom, provides us with date lines in the bottom sediments.

From the surface of the oceans water vapor constantly is rising which passes to the air above. This water vapor by the winds is carried inland where, condensing in the form of rain, it makes possible the growth of plants and through them of animals. In other words, our agricultural and associated industries depend for their existence upon conditions in the seas surrounding us. The rain which nourishes the farmer's wheat and the water which he gives his cows are merely wandering bits of ocean, from which they came and to which they will return after they have served their purpose.

Evaporation from the surface of the sea depends on temperature. On a warm day in summer the hot attic of a house is very dry, but the cool cellar damp, for air when cool can not hold nearly so much moisture as it can when warm. It also depends on the salinity or the amount of salts contained, for the greater the amount of salts dissolved the less will be the vapor pressure or the amount of water vapor given off.

Regarding the temperatures and salinities of the seas about our coasts, we have but little information sufficiently exact for present-day requirements, nor do we understand the details of the seasonal and daily changes.

The climate of our coastal regions is to a very large extent dependent upon conditions in the seas adjacent, upon the great warm currents like the Gulf Stream and Kuro Siwo, or upon cold currents coming from the polar regions or welling upward from the ocean's depths. These all require much more extended study, with much more accurate instruments than have been available heretofore, and with more regard to the details of the contours of the bottoms over which they flow, which are as yet inadequately known.

There are various other features connected with the sea which are of prime importance to the dwellers on the land. But I have said enough to show that the details of the oceanography of the seas surrounding us provide a most inviting field for fundamental research, and also that whatever aspect of the problem may be studied our people as a whole will benefit.

We can not leave the subject of marine investigations without expressing our admiration for the excellent work along the most modern lines now being carried on by the Bureau of Fisheries in cooperation with Harvard University, under the direction of Dr. Henry B. Bigelow; by the Scripps Institution of Oceanography under Dr. T. Wayland Vaughan; by the Coast and Geodetic Survey under Commander N. H. Heck and others, and by the Coast Guard in connection with the International Ice Patrol. This work, and more or less similar work abroad, particularly in England, is recasting the whole subject of oceanography; it is pioneering work of a most fundamental nature. Infinitely more detailed and more accurate than any previous work, it shows us that we must begin the study of our seas anew. The Bureau of Standards and the Navy are developing new types of instruments of far greater accuracy and speed of operation than any we have had before, most of which have not yet been put to use. Truly here is a won-

derful opportunity, acting in close cooperation with these men, to perform a most essential service. This the Smithsonian proposes to do along the lines which I have just outlined to you.

Why is the Smithsonian especially well fitted to undertake extensive oceanographic work? In the seventies and eighties when the Fish Commission was a part of the Smithsonian oceanographic work formed an important part of its activities. In recent years the Bureau of Fisheries has been able to do less and less extensive work in the non-economic phases of oceanography. The Smithsonian has in its custody all the collections made by oceanographic expeditions under government auspices, and, in addition, there are available to it the records and the data bearing on the subject in all the government departments. What, then, is more logical than that the Smithsonian, with the great collections in its charge, with a staff qualified to handle them and with its broad contacts, should undertake anew work along the lines in which it achieved so much distinction in the past?

With the cooperation of existing agencies, the Smithsonian now proposes a comprehensive program. To perfect methods the work will begin in a limited area where oceanographic investigations are readily made and will gradually extend to wider fields. It is proposed to determine the basic plant foods of the sea, on which all sea life depends, and to determine the food value to sea creatures of the bottom muds. From these biological beginnings, the work will expand to a survey of physical and chemical conditions, and of the interrelation of the various forms to one another and to the sea environment.

STUDIES ON INSECTS

In its third phase the Smithsonian's program contemplates a study of the insects. We live in a world replete with other forms of life competing with us for our food supply and even striving to consume the very substance of our bodies. Our chief competitors are the insects, of which more than six hundred thousand kinds are known and vastly more remain to be made known. In growing the crops and stock by which we live, our farmers spend their lives in constant costly warfare with the insects. The number of people who could be fed by the wheat or corn or other grain destroyed by insects, or clothed by the cotton or wool lost every year through insect depredations, represent the casualties on this battle line. We discount these casualties as "losses to the farmer," but take these figures and read them as losses to our army and see what that would mean. The two are quite alike in being both losses to our man power and all that that implies.

The weapons of the fighting armies always represent the highest attainable perfection of the moment. We know that this is necessary. We also know the habits and the customs of our fellow men. The hordes which the farmer is called upon to meet are mostly merely "bugs" to him, while his weapons seldom represent perfection. Each separate kind of "bug," however, is as distinctive in its way as is the human race itself, and must be thoroughly understood in order to be vanquished. Some of our more adaptable native "bugs" may unexpectedly change their habits, or at least seem to do so, especially on being brought into a new locality, and so become transformed from a harmless sort into a serious menace, while hordes of alien "bugs" exist in other lands, of which the gypsy-moth, the boll-worms, the Japanese beetle and the European corn-borer are but samples, waiting to cross the sea to us.

The vast improvement in the means of transportation, especially by automobiles, has in recent years greatly increased our danger from the insects through providing them with an easy means of traveling from one place to another quite unnoticed, hidden in produce or in merchandise. Besides this, our common practice of planting large areas with a single kind of crop year after year greatly assists the insects in their efforts to destroy it. They now find an immense supply of just the right kind of food provided for them and are enabled to increase accordingly. And with the growing extension of our commerce into other lands, we are beginning to feel the local influence of their insect pests.

By far the worst enemies of any insect are other insects of predaceous or parasitic types. As a striking illustration of what parasites can do, I may mention the extirpation of our native cabbage butterfly over most of its range in the United States by the European cabbage butterfly introduced into Quebec in 1858, from which locality it soon spread over most of eastern North America. These two pretty little butterflies are in no way hostile to each other and they live primarily on different food plants, the European preferring cabbage and the native various related native plants. The abundance of cabbages growing in our gardens soon led to an enormous increase in the numbers of the invader, while the native white grew scarcer. Now the native white has completely disappeared from nearly all the region it formerly inhabited in the United States. What is the explanation of this curious phenomenon? The caterpillars of these two related butterflies seem to be attacked by the same parasites. That of the European kind bores into cabbage heads and thus in a large measure escapes attack; that of the native always lives exposed, and therefore is always subject to attack. So the introduction of the European cabbage butterfly has killed

off our native one through greatly increasing the numbers of the parasites that attack them both, but from which the European, through the boring habits of the caterpillars, are to a large degree protected.

To indicate the extreme complexity of the insects' war upon each other I shall merely point out that the parasites that destroy the caterpillars are themselves preyed upon within the bodies of the caterpillars by other parasites which by destroying them serve to perpetuate the harmful insects.

The study of entomology is a vast web of interwoven facts full of incongruities and apparent contradictions, almost too vast for human comprehension. I do not need to labor this point, but I shall give one more example, that of those pretty and delicate little butterflies which as caterpillars feed wholly upon large and ferocious ants, especially the dreaded green "tree-driver." Ants are perhaps the most inveterate destroyers of the eggs and very young of nearly all the butterflies; yet no ant will ever hurt the eggs of any of the kinds of butterflies that feed on them.

We are fortunate in this country in having perfected to an extent found in no other land methods for the control of insect pests. But what we have done in this direction has already outstripped the facts upon which must be based really effective work. Our methods have been advanced beyond the detailed knowledge of the results achieved. In our methods of control we do not always know what it is we do.

It is the duty of the Bureau of Entomology to protect us from the ravages of insect pests. But work in economic entomology requires as a starting point an accurate identification of the insect to be studied. This provides the key by means of which we trace the facts concerning it through the literature.

The accurate identification of an insect is by no means a simple matter. In the first place, there are more than six hundred thousand different kinds of insects known, and at least three million more unknown. Of these, new kinds are being described at the rate of about six thousand every year. At this rate we shall still be describing new kinds of insects five hundred years from now. In the second place, in many types of insects the published information is so very widely scattered through such a vast number of different publications in various languages that, unless one happens to be an expert in the particular group concerned, it is almost hopeless to attempt to trace it out. In the third place, many insects, sometimes of widely different habits, are so very similar that it is practically impossible to distinguish them without an actual comparison by an expert with specimens in a reference collection. For instance, in the flesh-flies some kinds live as maggots in decaying meat, other kinds in living turtles, others in snails, and still others on the dead insects in the leaves of pitcher plants. But when these maggots, each with its distinctive habits, grow into adults, none but an expert can distinguish them.

We can see from all this that economic entomology must have the services of a staff of competent men trained to note the differences between the various kinds of insects. The Smithsonian proposes to aid in maintaining such a staff of workers in pure research. As a natural corollary to this work, the Smithsonian will publish monographs in which the widely scattered information will be presented as the basis for efficient advance.

So much for work in systematic entomology. Among the comparatively unexplored fields the physiology of insects offers the greatest promise. Our acquaintance with the insects is largely limited to their obvious relations to us. To deal successfully with them, we must know everything that they do and why they do it; we must understand the food elements necessary for the various types in all their stages and how they use them; their oxygen requirements and various other features. On this depends our knowledge of their tropisms and behavior, what is commonly called psychology in insects, and further our knowledge of the general ecology of insects, their relations with their food and other plants, with each other, with their parasites and enemies in general, and with those humbler forms of life causing disease among them. Here also the Smithsonian's research program contemplates investigation.

The subject of entomology is so very vast and the opportunities for fundamental and most useful work along lines essential to but not intruding on the economic field and not duplicating the efforts of any present student of the subject are so very great that the possibilities for real service, in close cooperation with the Bureau of Entomology and other organizations, and with interested individuals, here seems unlimited.

Under Smithsonian administration there is assembled one of the finest collections of insects in the world, which is constantly receiving additions from the Bureau of Entomology, from the Bureau of Animal Industry, and from other sources, both governmental and private. No other institution in the country offers such facilities for the carrying out of that extensive systematic work on which economic work ultimately depends.

STUDIES ON FOSSILS

What are the steps in life's progress from the age of trilobites to that of man? Do new forms of life appear suddenly, and, if so, what may we fear or expect of the future? The answers to these questions

lie imprisoned in the rocks—the fossils of animals that have lived in the past. But these extinct forms of life are more than historians. They are proving to be an important aid in the economic development of our country. They identify the rock strata and so serve as guides to indicate the presence of our oil, coal and other mineral resources.

A good example of this is furnished by the work of Dr. J. A. Cushman. For many years he devoted his attention to a most detailed and careful study of the recent and fossil Foraminifera, which form a very extensive group of small to minute creatures of, so far as was then known, not the least importance. But the small size of these objects renders them relatively little liable to breakage, either through the action of the waves along the shores, the changes due to the process of fossilization, or the fragmentation of the strata caused by boring operations. As a result of Dr. Cushman's studies, he discovered that these little animals are of enormous economic value in indicating, by the careful and exact determination of the various kinds represented in a sample, the presence of oil-bearing strata. It is not unlikely that other minute fossils will be found to be of corresponding economic interest and value.

During the past thirty years, large collections of fossils, invertebrates, vertebrates and plants have been accumulating under the administration of the Smithsonian Institution. Some of these collections represent fossil faunas that are new to science; others are from areas of which little is now known, and the further study of many others will greatly increase existing knowledge.

The Smithsonian desires to meet the obligation which rests upon it to investigate these, to translate and to interpret the great encyclopedia of facts represented by the fossils in the rocks, of which a large amount of unstudied material is now available and more is constantly coming in, chiefly from the Geological Survey.

As an example of what the Smithsonian has already done along these lines, I may mention the fundamental work of the present secretary, Dr. Charles D. Walcott, on the earliest known life, and especially on the fauna of the Cambrian.

Studies in Anthropology and Archeology

For the study of aboriginal man and the beginnings of culture, the Americas with their numerous Indian tribes provide an ideal field. But the fate of the Indian in North America is sealed. Many tribes have disappeared; others are constantly being drawn into the tide of higher civilization and their story and identity lost forever. The plough is burying traces of their past. Before it is too late, the Smithsonian proposes to continue its studies of the remains left by such peoples as the Basketmakers, the Pueblo Indians and cliff dwellers, the Mississippi mound builders, the Choctaw and Natchez; to discover who constructed the shellheaps which line our coasts and rivers, and to survey the supposed routes through Alaska by which the first human immigrants came to America.

Smithsonian anthropologists propose further to expand the work of thirty years past on the rise of man by investigation of sites in Africa and Java where important discoveries of primitive man have come to light.

In the custody of the Smithsonian there is the most extensive collection of American anthropological material to be found in this country, and in addition the most extensive collection of material bearing on the subject of physical anthropology, as well as the subject of early man. All this material is in charge of a staff of competent curators, working in collaboration with the staff of the Bureau of American Ethnology. With this background the Smithsonian is in a position singularly favorable for the prosecution of research in anthropology and ethnology.

Research on Animal Diseases

It is well known that there is often a distinct relationship between the diseases of man and those of the lower animals. Sometimes they are identical, sometimes very similar, and sometimes a disease of man is dependent upon one of the lower animals as an intermediate host. For instance, it has recently been shown that a peculiar disease called tularemia may be transmitted to man from wild rabbits through the bite of a fly.

The National Zoological Park, under the administration of the Smithsonian Institution, contains one of the finest and most complete collections of wild animals in the country. These are drawn from every land, from the Arctic, from the temperate zones, both north and south, and from every region of the Tropics.

It is proposed to establish in the park a laboratory adequately equipped for the study of the diseases of the animals—mammals, birds and reptiles—in the expectation, indeed the certainty, that much information will be gained which will assist in the solution of many problems connected with the diseases that afflict mankind.

At present the National Zoological Park cooperates so far as possible with the Bureau of Animal Industry in the Department of Agriculture and with the research department of the Johns Hopkins Medical School, both of which find in the park a rich field for their studies. The establishment of a laboratory in

the park will greatly assist cooperation with these institutions in addition to furnishing facilities for research work.

STUDIES ON PLANTS

To a scientific audience, it is not necessary to stress the fundamental importance of the exact determination of the material in any branch of natural science. An exact knowledge of the kind of plants with which one deals is an essential for the botanist. But the correct determination of the plants is by no means an easy matter. In the first place, there are some two hundred and twenty thousand different kinds of flowering plants alone, many differing only very slightly from others of quite different attributes. In the second place, in various groups we have as yet no very clear idea as to what characters separate the various kinds; much revisionary work of a fundamental nature remains yet to be done.

With the National Herbarium under its administration, the Smithsonian Institution is in a position singularly favorable for the prosecution of detailed, extensive and continuous work in systematic botany, working in cooperation with other institutions. Such work would very greatly aid and supplement the work of the Department of Agriculture and of numerous state and private agencies without in any way competing with them. Further, we must extend our information concerning the plants of regions as yet but little known.

Less is known of the plant life of northern South America than of almost any other section of the Western Hemisphere. Before plants yielding drugs, gums, fruits, fibres, dyes and oils can efficiently be made available to the world, they must be discovered, named and described. In an expansion of work already begun, the Smithsonian in cooperation with four other institutions plans as part of its botanical program to study the plants of Colombia, Ecuador and Venezuela.

RESEARCH ASSISTANTS

The first essential for any effective work is men. All the equipment, material and tools in the world are of little value without capable men to handle them. We all admit that not every one can be an artist, though it is not so commonly realized that not every one can be developed into a first class scientific man. In so far as research in pure science means the discovery of new facts and their interpretation, the number of men who can achieve success in this field is limited. Really first-class research men must be developed from a basis of superior natural abilities, and during their development they must be prepared to undergo a long and grueling apprenticeship.

What do we find the situation of pure research to be with regard to the men engaged in it? In the first place, the men are far too few in numbers. The superior and more immediate rewards in applied science are thinning the ranks of those seeking new facts without regard to their economic application. Mr. Hoover recently calculated the number of workers in pure science to be three thousand as against thirty thousand in applied science. And yet these thirty thousand are comparatively helpless without the basic work of the three thousand.

This is a serious situation. That part of the Smithsonian program which contemplates the securing and training in research of superior men is therefore of prime importance.

In what way does the Smithsonian propose to train these men?

The National Museum, under the direction of the Smithsonian Institution, is the legal repository of all collections made by the various governmental agencies and of the data accompanying them. Thus, for instance, the plants, vertebrates, animal parasites and insects gathered by the Department of Agriculture, the marine life and the bottom samples gathered by the Bureau of Fisheries, the Coast Guard, the Navy and other agencies, and the fossils and minerals gathered by the Geological Survey are all deposited in the National Museum.

All these collections are under the immediate care of a staff of curators and their assistants who are responsible for their upkeep, and who are expected to devote such time as may be spared from their strictly curatorial duties to increasing the value of the collections in their care by a detailed study of them leading to the discovery of new facts. The first responsibility of the curators is the care of the collections. These are so large and are increasing so rapidly that their available time for original work upon them is limited.

Here the Smithsonian offers a unique opportunity for giving experience in pure research along certain lines, for preparing selected men and women for fundamental research out of which eventually is bound to come the highest type of constructive economic work. How does the institution propose to do this? The Smithsonian has more freedom of action in pure science than any of the governmental agencies and is exceptionally well placed to undertake investigations in pure science, not only in restricted subjects, but also along lines involving several different branches of science. With increased resources the institution plans to take on each year a certain number of promising young men and women in the capacity of research assistants. These research assistants will get their training under the guidance of men of established reputation, and will be privileged to work

upon collections which certainly are not surpassed in interest and in extent anywhere in this country. They will see science as a whole and thus will get a larger perspective than if they were working in an isolated field or in an isolated place; and furthermore constant contact with men in other lines of scientific activity will stimulate interest and understanding.

In this way the Smithsonian Institution confidently expects not only to build up its own staff, but also to increase the number of trained men available for pure research in the country, and in doing both greatly to increase the value of the collections under its administration.

EXPLORATIONS

From its inception the Smithsonian has been interested in exploration. Heretofore exploring expeditions have been largely in the nature of collecting trips which as they went along gathered up material of every sort from the regions that they traversed. So much has now been done that such general expeditions no longer yield results commensurate with the expense involved. We have a pretty good idea of the general features of the world, so that general expeditions increasingly result in duplicating work already done with the resultant waste of effort.

We have now reached the time when fruitful and efficient exploration can be undertaken only after adequate study and preparation, with very definite aims in view and with as many different lines of scientific work as possible served in each endeavor. Intensive rather than extensive exploration is the need to-day, equally in zoology and in botany.

The Smithsonian Institution plans from time to time, as occasions may arise or as opportunities may offer, to send out expeditions to those regions as yet but little known, especially in Central and in South America, expeditions thoroughly equipped and with a personnel competent to carry on at the same time many different though correlated lines of work. As in the past it is expected that these expeditions will often be undertaken in cooperation with other institutions.

PUBLICATIONS

In any country progress in science is dependent on the appreciation of an interested public. The theory that it is the hobby of the rich and leisure classes and that effective advance can be made in it thanks to the restricted patronage of a Louis XIV will not hold water. Isolated steps may be taken in such a way, but a great sound body of science can no more be built without the interest and backing and yes even participation of a large part of the population than the Cathedral of Chartres could have been built by the nobles of Beauce alone. The best science, like the finest art, belongs to the people and must express their interests.

I suppose that no one will deny that England with her Newtons, her Faradays, her Darwins, her Lubbocks, leaders in every branch of science, holds first place in the discovery of basic scientific principles. It is equally undeniable that interest in science among the common people is greater in England than in any other country. There exist in that country any quantity of scientific societies made up largely of working men and tradesmen. The relationship between these two sets of facts is beyond question.

So much to indicate the dependence of scientific advance upon popular support. What of America? We are to-day witnessing a flowering of interest in science in this country which is without precedent. A number of startling achievements such as the automobile, the aeroplane, the radio, the X-ray—all products of pure research—have forcibly impressed upon every man the concrete significance of science to himself. Science owes it to itself to meet this new-born interest and to nourish it. And the medium through which it must work to these ends is primarily the press—newspapers, magazines, books. We have got to devote an increasing share of our attention to publication.

So far as newspapers and magazines are concerned, the interest exists. We do not have to create it. Our responsibility and opportunity consist in providing accurate material and plenty of it. Where we must stimulate publication is in the presentation of the results of research in pure science, and that is commonly presented in technical treatises and monographs.

Our facilities in this respect as a result of the increased cost of printing and as a result of the growing demand for popular enlightenment have fallen far behind what they were two decades ago. Yet the necessity for such publication has increased enormously, while far more first-class material is produced than can possibly be taken care of. Each of you here either has manuscripts of your own or knows of others containing the results of work to which years have been devoted hidden away with no immediate prospect of publication. This is particularly true in regard to comprehensive monographic works, invaluable summaries of the life studies of able men, in which all previous information on the subject treated is included.

Monographs are the stepping stones to more efficient work through summarizing all that has been done before. The value of the time saved to students by each such comprehensive work may safely be measured in thousands of dollars.

It is safe to say that without adequate facilities for publication research work is largely futile. No scien-

tific man any longer works alone. All future advances must be based on what other men have done, and the further the advance the more this is true. Perhaps the greatest scientific need to-day is for vastly increased facilities for the publication of results of research in pure science. The recognition of this fact is no new thing on the part of the Smithsonian Institution. In the founder's single statement of purpose —"for the increase and diffusion of knowledge among men"—publication is given a place in importance equal to research. As Secretary Henry said in his plan of organization drawn up in 1846, "Knowledge can be most successfully diffused among men by means of the press."

In obedience to the expressed will of James Smithson and to the interpretation thereof by Joseph Henry, the Smithsonian has for eighty years maintained a definite program of publication with such success that these publications have come to be among the best-known books of the scientific libraries of the world. Who among you does not know of the "Contributions to Knowledge" series, of the "Miscellaneous Collections," of the "Smithsonian Physical Tables"? These various series include the results of pure research in widely different lines of science, many of which would never have been published had not the Smithsonian undertaken the work.

Not only has the Smithsonian faithfully striven to publish the results of as much fundamental research work as possible, but it has made sure that these publications would do the greatest amount of good by the free distribution of them among scientific bodies and libraries in all parts of the world. It is no uncommon thing for a traveler in Siam, for instance, in Borneo, in Nairobi, in Uruguay, in Queensland to come upon local scientific groups, the libraries of which give a place of honor to the torch of the Smithsonian publications.

In recent years the greatly increased cost of printing has forced the Smithsonian to suspend the "Contributions to Knowledge" series altogether, and to reduce the "Miscellaneous Collections" to a third of the number published annually before the war. While I have no desire to overdraw the picture, I can not forbear calling this a tragedy. The Smithsonian Institution earnestly desires not only to resume publication on the former scale, but to increase it to an extent more nearly commensurate with modern needs.

In this ambition we know that we can count upon the support of every man of science in America.

The Future

At the present time the enormous extension of applied science and its superior rewards are attracting to this line of work much of the best material from among the graduates and from the faculties and staffs of our educational and other institutions. Consequently the sources to which we must look for the elaboration of new ideas and theories are gradually drying up. The application of facts already known is outrunning the discovery of new facts. And yet application is dependent upon discovery; it can not come before. Our first duty, therefore, is to support agencies for the discovery of new facts.

Quite apart from the ultimate materialism of this point of view, such mining for new truths is the nearest approach that man can make to the intriguing realm of the unknowable. Such mining will assist man's spiritual growth, while at the same time adding to his material prosperity. Let us not turn aside from this opportunity.

The Smithsonian Institution is consecrated to a definite program of research in pure science and the publication of the results thereof. So it has been for eighty years. So it is now that we are on the threshold of new endeavors. You know what the institution has done. I have told you what it proposes to do. In carrying out its program for research, publication and the training of promising men and women, the Smithsonian will perform a fundamental service to the American people and to the American government. Only by the performance of such service will it continue worthy of the traditions of achievement which have made it "The Smithsonian Institution."

AUSTIN H. CLARK
SMITHSONIAN INSTITUTION

EDWARD SYLVESTER MORSE

PROFESSOR MORSE, son of Jonathan K. and Jane Seymour (Beckett) Morse was born in Portland, Maine, June 18, 1838, and died at Salem, Mass., Dec. 20, 1925. Like most naturalists he early showed an interest in natural history, amassing a notable collection of shells at the age of thirteen, and what is less common, he developed unusual artistic ability. He made for Dr. William Stimpson numerous admirable drawings of living mollusks of the Maine coast. In 1859 he became one of Louis Agassiz's special students at the Museum of Comparative Zoology, where he pursued his studies until 1862 when he published his first paper on brachiopods, a subject to which he later made notable contributions. His first paper to attract particular attention was devoted to some very minute landshells of Maine, illustrated by his own drawings and proposing new generic names for several of them based on anatomical characters. This paper, published in 1864, was the precursor of a long series of studies by Bland, W. G. Binney and

Pilsbry, which have revolutionized the classification of the landshells.

About this time he prepared the beautiful series of drawings which illustrate Binney's edition of Gould's Invertebrata of Massachusetts.

In 1871 he became professor of comparative anatomy and zoology at Bowdoin, remaining until 1874, and also gave a series of lectures at Harvard. In 1876 he was elected a member of the National Academy of Sciences and the following year went to Japan, led chiefly by the desire of studying the Japanese brachiopoda, in which that region is so rich. He received the appointment of professor of zoology at the University of Tokyo, which he filled with great success, returning in 1880 with a large collection and signal honors from the Japanese government. During this period his ready pencil was active in taking notes which later formed the basis of his volume on Japanese homes, and other contributions to our knowledge of the Japanese people for whom he always cherished a profound admiration. At this time too his artistic taste recognized the beauty of the common pottery of Japan, and he made of it the remarkable collection which is one of the treasures of the Boston Museum of Fine Arts.

On his return to Salem he became director of the Museum of the Peabody Academy of Sciences and so remained, being named director emeritus on his retirement. His work in this institution made the museum the custodian of the most artistically and scientifically arranged minor collection in the United States, if not in the world. After a wide inspection of European museums, the only one which even seemed to approach the Peabody in these respects is the Royal Cabinet at Stuttgart.

In 1886 Morse was elected president of the American Association for the Advancement of Science, and in the intervals of activity at Salem lectured acceptably in many parts of the United States. Long years a widower he leaves a son and daughter and four grandchildren.

The salient characteristic of Professor Morse, apart from his devotion to science and love of the beautiful in art, was his boyish enthusiasm which captivated all who knew him. The versatility of his interests was unbounded, his love of fun overflowed at every opportunity; to meet him was to find a welcome. The world was brighter for his presence.

WILLIAM H. DALL

SCIENTIFIC EVENTS

THE NATIONAL RESEARCH ENDOWMENT

FOLLOWING a conference of public men and scientists, who have consented to serve as a board of trustees of a National Research Endowment to obtain immediate support and encouragement for pure science research in the United States, this declaration was made public on February 1.

The Trustees of the National Research Endowment, recognizing that human progress depends in large degree upon research in pure science, declare their conviction:

(1) That the United States, which already occupies a leading position in industrial research, should rank with the most enlightened nations in the advancement of pure science.

(2) That it is wiser to make large expenditures for scientific research, thus advancing civilization, improving human welfare, conserving health and saving countless useful lives, than to tolerate suffering and then endeavor to alleviate it at still greater cost.

(3) That research in all branches of the mathematical, physical and biological sciences should be encouraged, because of the intellectual and spiritual value of adding to knowledge and because the greatest advances in science and in industry often result from apparently useless abstract discoveries.

(4) That scientists exceptionally qualified to widen fundamental knowledge through research are of such value to the nation that every effort should be made to facilitate their work.

(5) That the overcrowding of educational institutions, and the consequent excessive demands of teaching and administration, have further reduced the limited opportunities for research previously enjoyed by the members of their faculties.

(6) That the funds now available for the support of research in pure science in the United States are far below what our population, education and material resources demand.

(7) That the National Academy of Sciences, created by congressional charter the scientific adviser of the government, and composed of leading investigators in the closely interlocked and mutually dependent mathematical, physical and biological sciences, is peculiarly qualified to evaluate the needs of pure science in America, to stimulate its progress and to insure the widest use of funds provided for research.

In view of these considerations, the Trustees of the National Research Endowment, established by the National Academy of Sciences, propose immediately to secure adequate funds for the encouragement of research in pure science.

Those in attendance at the organization meeting of the special board of trustees, appointed recently by the National Academy of Sciences for the fund, were: Secretary Hoover, *chairman;* Albert A. Michelson, president of the National Academy of Sciences; Gano Dunn, chairman of the National Research Council; Vernon Kellogg, permanent secretary of the National Research Council; Elihu Root, Col. Edward M. House, Cameron Forbes; Henry S. Pritchett; Dr. Robert A. Millikan, foreign secretary of the National Academy of Sciences; Dr. John C. Merriam, president of the

Carnegie Institution of Washington; Owen D. Young; Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research; Dr. John J. Carty, vice-president of the American Telephone and Telegraph Company; Dr. William H. Welch, director of the School of Hygiene and Public Health of Johns Hopkins University; Professor A. B. Lamb, of Harvard University; Professor Oswald Veblen, of Princeton University; Dr. Thomas H. Morgan, of Columbia University; Dr. George E. Hale, director of Mount Wilson Observatory, Pasadena, California.

Other members of the fund's special board of trustees are: Andrew W. Mellon, Charles E. Hughes, Henry M. Robinson, John W. Davis, Julius Rosenwald, Dr. James H. Breasted, director of the Oriental Institute of the University of Chicago, Felix Warburg and Professor L. R. Jones, of the University of Wisconsin.

APPROPRIATIONS FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE

THE annual agricultural department supply bill was reported in the house on January 23 by the appropriation committee. The measure provides for a total expenditure of $126,220,000 during the fiscal year, representing an increase of $486,000 over last year's bill, but a decrease of $3,245,000 from budget estimates.

For continuance of federal aid to states in road construction the measure recommends appropriation of $75,000,000, which is $1,000,000 below current funds, but increasing from $4,000,000 to $5,000,000 funds for building forest roads and trails.

The bill allots $2,521,000 to the Weather Bureau, an increase over current funds of $178,165, which the committee explained is necessary to cover an increase of $147,000 in telegraphic tolls on transmitting weather reports and to provide for additional field stations.

For farmers cooperative demonstrations, the measure again appropriates $1,308,000, while $630,000, an increase of $20,000, is recommended for the inspection and quarantine work of the Bureau of Animal Industry.

A total appropriation of $1,440,000 is made for agricultural experimental stations, in accordance with the Purnell Act of the last Congress. This is an increase of $480,000 over current funds.

Other appropriations include: Bureau of animal industry, $8,369,000, decrease of $15,000; bureau of dairy industry, $490,790, decrease of $5,000; bureau of plant industry, $3,853,000, decrease of $28,000; forest service, $8,232,000, increase of $38,000; bureau of entomology, $2,606,000, increase of $51,000; bureau of agricultural economics, $4,731,000, decrease of $6,000.

To purchase land to be included in the upper Mississippi River wild life refuge, the bill appropriates $25,000 compared with a current appropriation of $400,000. The report explained that inasmuch as work on this project did not start until the beginning of the present fiscal year, the recommended appropriation with that remaining from current funds would be sufficient.

THE GUGGENHEIM FUND FOR AERONAUTICS

THE endowment of chairs of aeronautics in universities in the West, South and Southwest is proposed by the Daniel Guggenheim fund for the promotion of aeronautics, which will spend $2,500,000 to foster aeronautical science in the next ten years.

Daniel Guggenheim has given $500,000 to New York University for an aeronautical school there. The Boston School of Technology already has such a course. The demand for technical education in flying in the East is thus considered to be met. Besides endowing professorships, a school of aeronautics may be founded in some engineering college on the Pacific Coast.

Harry F. Guggenheim suggested that the fund might encourage trade schools to set up courses in plane building and rigging. He suggested also that fellowships be founded enabling engineering graduates to take postgraduate courses at aeronautical schools. Other fellowships would send aircraft students abroad.

Other research under consideration includes problems in connection with helicopters, radio direction finders and leader cables. Fundamental research in aerodynamics is also to be encouraged.

MEETING OF THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION

THE seventh annual meeting of the Southwestern Division of the American Association for the Advancement of Science will be held in Phoenix, Arizona, on February 15, 16, 17 and 18, under the presidency of Professor T. D. A. Cockerell, of the University of Colorado.

The plans for the meeting include many lectures which will be of interest to the general public as well as to men and women of science. These will be delivered at the general sessions of the division. The section programs are being planned with especial care and it is anticipated that these meetings will prove more profitable and interesting than ever before. The custom of a noon-day luncheon, followed by a symposium, has become an established feature of the

division meetings. Symposia topics for the coming meeting include research, archeology, education and radiation.

Registration and all section meetings will be held in the educational rooms of the First M. E. Church, on the northwest corner of Second Avenue and Munroe Street. General sessions, in the afternoon and evenings, will be held in the High School Auditorium, East Van Buren Street. Announcements concerning luncheons, excursions and other special features will appear on the general program.

All members of the association are urged to prepare papers dealing with their original research in any line and submit titles of such papers to the proper section chairman. Those who are to present papers or are to deliver addresses at the Phoenix meeting are requested to prepare, as soon as possible, two copies of an abstract of the paper or address, not to exceed twenty-five lines in length. One copy of this abstract and a copy of the manuscript should be sent to the chairman of the section before which the paper is to be read. The other copy of the abstract should be sent to Dr. Elliott C. Prentiss, 515 Roberts Banner Bldg., El Paso, Texas. The time limit for reading papers is twenty minutes.

Phoenix is well equipped to take care of members or others in attendance from distant points. Hotel accommodations may be arranged for through Robert Q. Grant, U. S. Weather Bureau, Phoenix. Plans for excursions to points of interest and other entertainments will be announced in the general program. At least one all-day archeological excursion is planned. The Salt River Valley is rich in archeological material, and an opportunity will be afforded to see the most important features.

Section chairmen for the meeting are as follows:

Biology: Professor Charles T. Vorhies, University of Arizona.
Education: Dr. Frank C. Lockwood, University of Arizona.
Medical Science: Dr. Gerald B. Webb, 402 Burns Bldg., Colorado Springs.
Physical Science: Dr. O. C. Lester, University of Colorado.
Social Science: Professor E. B. Renaud, University of Denver.

SCIENTIFIC NOTES AND NEWS

THE Academy of Natural Sciences of Philadelphia announces that the 1926 Hayden Memorial Geological Award will be made to Dr. William Berryman Scott, professor of geology at Princeton University. The award will be made in recognition of Dr. Scott's "many researches and publications in the field of vertebrate paleontology." The committee on the Hayden Memorial Geological Award for 1926 consists of the following individuals: Dr. R. A. F. Penrose, Jr., *chairman,* Dr. Henry Fairfield Osborn, Dr. Henry A. Pilsbry, Dr. Charles D. Walcott and Dr. Edgar T. Wherry. The award, which consists of a gold medal, is made once in three years, and was founded as a recognition of preeminent work by "publication, exploration, discovery or research in the sciences of geology and paleontology."

PROFESSOR ROBERT A. MILLIKAN, director of the Norman Bridge Laboratory of Physics at the California Institute, will give a course of lectures at Cornell University next spring under the provisions of the Hiram J. Messenger Foundation.

DR. E. W. WASHBURN, editor of the "International Critical Tables," has been appointed chief of the chemical division of the U. S. Bureau of Standards.

PROFESSORS ANTON J. CARLSON and Arno B. Luckhardt, of the department of physiology at the University of Chicago, have been elected foreign members of the Deutsche Akademie der Naturforscher, Halle, Germany, founded in 1652.

PROFESSOR A. S. HITCHCOCK, custodian of grasses, U. S. National Herbarium, has been elected a corresponding member of the German Botanical Society.

ROBERT M. GREY, superintendent of the botanical gardens in Cuba of the Harvard Institute for Tropical Biology and Medicine, maintained under the Atkins Foundation, has been awarded the Meyer memorial medal by the American Genetic Association for his introduction of plants into Cuba and for the production of new varieties of sugar cane.

THE Society of American Bacteriologists has elected the following foreign bacteriologists to corresponding membership: Winogradsky (Russia-France), Beijerinck (Holland), Omeliansky (Russia), Neufeld (Germany), Kitasato (Japan). There are now eighteen corresponding members representing various foreign countries.

DR. OLOF JONASSON, of Stockholm, who has been studying in this country under the auspices of the American Scandinavian Foundation, was awarded an honorary Ph.D. in geography by Clark University on February 1, on the occasion of the founders day exercises of the university.

DR. WILLIAM W. KEEN, emeritus professor of the principles of surgery and clinical surgery, Jefferson Medical College, celebrated his eighty-ninth birthday on January 19.

THE well-known psychologist, Professor V. M. Bekhterev, of the USSR Academy of Sciences, is celebrating this year the 40th anniversary of his scientific career. The Council of People's Commissaries has granted 25,000 roubles for the equipment

of the Reflexological Brain Institute founded by Bekhterev; 5,000 roubles were assigned for the publication of a jubilee edition, besides a personal annuity to Professor Bekhterev.

DR. WILBUR A. NELSON, professor of geology at the University of Virginia, was reelected president of the American Association of State Geologists at the recent meeting in New Haven.

OFFICERS have been elected to the American Society of Biological Chemists for the year 1926 as follows: *President,* E. C. Kendall; *vice-president,* E. V. McCollum; *secretary,* F. C. Koch; *treasurer,* G. E. Cullen; additional members of the council: J. B. Collip, E. A. Doisy, A. P. Mathews.

DR. FREDERIC S. LEE, research professor of physiology in Columbia University, has been reelected president of the board of managers of the New York Botanical Garden for 1926. Other officers have been chosen as follows: *Vice-presidents,* Henry W. de Forest and F. K. Sturgis; *treasurer,* John L. Merrill; *secretary,* Nathaniel L. Britton.

C. C. CALDER, curator of the herbarium of the Royal Botanic Garden, Calcutta, has been appointed director of the Botanical Survey of India and superintendent of the Royal Botanic Garden, Calcutta, and of cinchona cultivation in Bengal.

GEORGE W. HERVEY, of Rutgers University, has been appointed as biometrician in the U. S. Bureau of Dairying to assist in the study of the underlying principles governing the heredity of milk and butterfat producing ability in dairy cattle.

C. G. DUNKLE, secretary of the Pittsburgh Section of the American Chemical Society, has been appointed to a research fellowship in mining and metallurgy at the Carnegie Institute of Technology to fill the vacancy caused by the death of Benjamin E. Hess, a graduate of California Institute of Technology, who was killed on December 19 in a train wreck.

ARTHUR D. LITTLE, Inc., of Cambridge, Mass., announce the addition to their staff of Dr. A. W. Francis, formerly a National Research fellow; Dr. Christian V. Holland, who has been engaged in natural gas work, and Thorne L. Wheeler, of Wheeler and Woodruff, New York.

HAROLD B. PIERCE is leaving Pennsylvania State College on a leave of absence granted for one year, to study with Dr. John R. Murlin, of the University of Rochester, under a Fleischmann fellowship.

DR. L. A. MAYNARD, professor of animal husbandry in Cornell University, has been given a leave of absence for the second term of the current academic year for study in the laboratory of physiological chemistry at Yale University.

DR. JOHN MEAD ADAMS, of the southern branch of the University of California, has been granted leave of absence for the second half of the current academic year, to carry on an investigation of the conditions governing the formation and growth of snowflakes.

HERBERT E. GREGORY, professor of geology in Yale University, left New Haven early in February. He will spend the remainder of the year in Honolulu as director of the Bernice P. Bishop Museum.

DR. ATHERTON SEIDELL, of the U. S. Public Health Service, has sailed for Paris where he will continue his research on vitamins at the Pasteur Institute. He expects to return to the United States next August.

DR. BRADLEY M. DAVIS, professor of botany at the University of Michigan, will spend the months of March, April and May in Jamaica, where he may be addressed care of the United Fruit Company, Kingston.

DR. A. S. PEARSE has been granted a year of leave from the University of Wisconsin, beginning February, 1926. Until July 1 he will be at the London School of Tropical Medicine. He will then go to Lagos, Nigeria, where he will be associated with the yellow fever unit of the International Health Board.

ERNEST F. BURCHARD, of the U. S. Geological Survey, has returned from a trip across South America from the Pacific to the Atlantic coast, having examined iron-ore deposits in Misiones Territory and in Catamarca Province for the Argentine government.

M. HENRI CORREVON, of the Jardin Alpin d'Acclimatation at Geneva, Switzerland, is making a lecture tour in the United States. On February 17, he will give an address at the Colony Club, New York City, under the auspices of the New York Horticultural Society.

DR. WOLFGANG KÖHLER, professor of psychology in the University of Berlin, who has been lecturing at Clark University during the past year, has left for Germany to resume his chair at Berlin.

HAVING completed his work on the Atlantic eel, Dr. Johs. Schmidt, director of the Carlsberg Laboratory, Copenhagen, is now taking up the study of the eels of the Indo-Pacific area. He recently left on an expedition to the Pacific to collect specimens and make observations and expects to be absent for about six months.

N. A. JOYCE, deputy keeper of the department of ethnology of the British Museum, will leave this month for British Honduras to study the Maya civilization in Central America.

PROFESSOR MAX BORN, of the University of Göttingen, has completed his lecture courses at the Massa-

chusetts Institute of Technology and is now visiting the California Institute of Technology. Later in the month he will give the Hitchcock lectures at the University of California. Before leaving for Germany on March 24, Professor Born will give lectures at Wisconsin, Columbia, Princeton and in Washington.

DR. JOHN J. ABEL, of the Johns Hopkins University, gave the sixth Pasteur lecture before the Institute of Medicine, Chicago, on January 22 on "Some Thoughts and Experiments in Relation to Hormones."

DR. WILLIAM F. BOOK, professor of psychology at the University of Indiana, was the principal speaker at Clark University on the occasion of the founders day exercises on February 1.

ON January 15, Dr. Aleš Hrdlička lectured before the trustees and guests of the Buffalo Society of Natural Sciences on "Early Man and Anthropological Problems of Far South East and South Africa." He also gave on the same date a talk on "Items of Anthropological Interest" before the Buffalo branch of the Phi Beta Kappa society.

PROFESSOR ROSS AIKEN GORTNER, of the University of Minnesota, lectured on "Colloid Chemistry and Biology" at the University of Saskatchewan on January 14, at the University of Alberta on January 16 and at the Agricultural College of the University of Manitoba on January 18.

H. E. HOWE, editor of *Industrial and Engineering Chemistry*, has recently returned from addressing a number of open forums in Florida on the subject of "Wasteful America."

DR. E. D. BALL addressed the recently organized Sigma Xi Club, of the University of Florida, at its first regular meeting on January 20. His subject was "The Training and Compensation of the Scientist."

ON January 16, Dr. Leslie C. Coleman, director of the Department of Agriculture, in Mysore, India, delivered an address to the Royal Canadian Institute on the subject "Rural Life in India and Its Improvement." Dr. Coleman is at present on leave of absence and engaged in research at the Botanical Laboratories of the University of Toronto.

PROFESSOR MONROE B. SNYDER, director emeritus of the Philadelphia Observatory, read a paper on "Universal Atomic Volcanism and the Millikan Cosmic Rays," before the American Philosophical Society, Philadelphia, on January 20.

THE Proctor Foundation lecture was delivered on January 16, at the Brooklyn Academy, by Dr. H. H. Sheldon, associate professor of physics at New York University, who spoke on "Atomic Structure and Transmutation."

DR. FRANCIS PEYTON ROUS, of the Rockefeller Institute for Medical Research, addressed the College of Physicians, Philadelphia, on January 6, on "The Phenomena of Biliary Obstruction," and Dr. Arthur D. Hirschfelder, of the University of Minnesota, on "The Laboratory Point of View in Clinical Medicine."

ON January 14, Professor W. H. Twenhofel, of the University of Wisconsin, gave a lecture before the University of Indiana chapter of Sigma Xi on the subject of "The History and Geology of Anticosti Island." On January 15 he addressed the faculty and students of the department of geology upon the subject of "The Problems of Sedimentation."

PROFESSOR W. D. HARKINS, of the University of Chicago, lectured on January 12, at the school of chemistry at the University of Minnesota, on "The Formation and Disintegration of Atoms."

IRA D. VAN GIESEN, electrical engineer, in charge of electrolysis mitigation for the department of water and power of the city of Los Angeles, gave an illustrated lecture on "Electrolysis," before the Los Angeles Section of the American Institute of Electrical Engineers, on January 5.

A STREET in Brussels near the university has been named after the late Professor A. Depage.

DR. RALPH W. TOWER, librarian of the American Museum of Natural History and formerly assistant professor of physiology at Brown University, died on January 26, aged fifty-six years.

DR. G. A. H. KELLNER, director of the scientific laboratory of the Bausch and Lomb Optical Co., Rochester, died on January 28, aged fifty-two years.

WILLIAM TUFTS BRIGHAM, emeritus director of the Bishop Museum of Ethnology at Honolulu, has died at the age of eighty-four years.

PROFESSOR WILLIAM WARREN BIRD, for many years head of the mechanical engineering department at the Worcester Polytechnic Institute, died on January 24.

DR. PATRICK E. QUINN, authority on animal diseases, connected with the United States Department of Agriculture for thirty years, died on January 18, aged fifty-three years.

DR. ARCHIBALD CUNNINGHAM HARRISON, professor of surgery at the University of Maryland School of Medicine and College of Physicians and Surgeons, died on January 17, aged fifty-two years.

DR. JOHN FLOCKER BIDDLE, professor of clinical pathology and surgery in the University of Pittsburgh, has died.

DR. O. L. POTHIER, of Loyola University, New Orleans, and formerly a member of the Rockefeller Com-

mission to Study Tropical Fevers in South America, died on January 23.

ANNIE PARKER HENCHMAN died at Cold Spring Harbor on January 13 in the seventy-fourth year of her age. She published papers on the development of the nervous system of Limax and on variation in the statoblasts of fresh water Bryozoa.

DR. CAMILLO GOLGI, emeritus professor of histology at the University of Pavia, who was awarded the Nobel prize in 1905 for his work on the nervous system, died on January 21, aged eighty-six years.

DR. RICHARD CATON, emeritus professor of physiology at the University of Liverpool, has died at the age of eighty-four years.

J. H. MAIDEN, F.R.S., until recently director of the Sydney Botanic Gardens, died on November 17, aged sixty-seven years.

PROFESSOR WILLIAM HENRY WARREN, Challis professor of engineering in Sydney University and president of the professorial board, has died, aged seventy-four years.

M. SIMON, professor of organic chemistry at the Museum of Natural History, Paris, has died.

DR. J. BARTEL, associate professor of pathology at Vienna, and for many years assistant to Professor Weichselbaum, has died, aged fifty-two years.

THE one hundred and thirty-eighth regular meeting of the American Physical Society will be held at Stanford University on March 6.

THE fourteenth annual meeting of the Eugenics Research Association will be held at the Eugenics Record Office on June 26, 1926. Members of the association who have studies to report are invited to communicate with the secretary of the program committee of the Eugenics Research Association, Cold Spring Harbor, Long Island, N. Y.

THE next annual Congress on Medical Education, Medical Licensure, Public Health and Hospitals will be held in the gold room of the Congress Hotel, Chicago, on February 15, 16, 17 and 18. On February 15 and 16, the Council on Medical Education and Hospitals of the American Medical Association will hold its twenty-first annual conference. On February 17, the Federation of State Medical Boards of the United States will hold its annual session. On February 18, the annual session of the American Conference on Hospital Service will be held.

THE American Electrochemical Society will hold its spring meeting at the Chicago Beach Hotel on April 22, 23 and 24, 1926. A feature of the program will be a symposium on chlorine under the direction of D. A. Pritchard, of the Canadian Salt Co. Twelve or more of the leading producers and consumers, government experts and university men will discuss such phases as chlorine cells, transportation problems, chemical warfare, uses in the organic chemical industry, including petroleum, in metallurgy and in making chlorides. There will be two round table discussions, one on plating, and another on the relative merits of electric and gas-fired furnaces. The Friday evening meeting will be a joint session with this section, for which an effort is being made to secure a distinguished English authority on electrochemical cells as speaker. Fred'k M. Becket, of the Union Carbide and Carbon Co., is president and Professor C. G. Fink is secretary of the society.

AT the meeting of the Society of the Sigma Xi at the University of Pennsylvania on January 20, two addresses were given containing the discussion of "Organic Evolution in the Light of recent Biological Research." Dr. A. F. Blakeslee, of the Carnegie Institution Laboratory of Experimental Research at Cold Spring Harbor, spoke on the "Origin and Nature of Mutations and their Probable Place in Evolution." Professor Rodney H. True, of the botanical department of the University of Pennsylvania, spoke on "Structural Differences considered as Results of Physiological Evolution."

ACCORDING to the *Journal* of the American Medical Association, the dean of Tulane University of Louisiana School of Medicine announced a special medical meeting to be held in the Hutchinson Memorial Building, January 15. Dr. William T. Councilman, emeritus Shattuck professor of pathologic anatomy at Harvard University, gave an address on "Medicine in China"; Dr. Aldo Castellani, recently appointed head of the department of tropical disease at Tulane, spoke on "Tropical Diseases."

A COURSE of lectures on experimental science and medical progress will be given under the auspices of the Peoples Institute at the Cooper Union, New York City, on Tuesday evenings at eight o'clock as follows: February 9, "From Test Tubes to Living Things," Dr. Hugh S. Taylor, Princeton University; February 16, "What we have learned of the Heredity and Development of the Organism," Dr. Charles R. Stockard, Cornell University Medical College; February 23, "What we have learned of the Nutrition of the Organism," Dr. Walter H. Eddy, Teachers College, Columbia University; March 2, "The Adjustments and Unity of the Organism," Dr. William A. White, St. Elizabeth's Hospital, Washington, D. C.; March 9, "Preventing Sickness and prolonging Life," Dr. C-E. A. Winslow, Yale University School of Medicine; March 16, "The Scientific Attitude and Public

Health," Dr. George E. Vincent, Rockefeller Foundation.

FREE lectures and demonstrations will be given during the month of February in the Central Display Greenhouse, New York Botanical Garden, on Saturdays at 3 P. M. as follows: February 6, "Notes on the Birds in the Botanical Garden," R. S. Williams; February 13, "Trees and Shrubs in Winter," Percy Wilson; February 20, "Methods of breeding Plants," Dr. A. B. Stout; February 27, "The Planting of Flower Seeds," George Friedhof.

ACCORDING to press dispatches, the Italian cabinet has approved a bill creating an Italian Academy, the objects of which will be the "coordination and direction of Italian intellectual movements in the field of science, letters and arts, the preservation in these activities of the national character according to the traditions of the race, and the encouragement of its expansion and influence abroad." The academy will receive an annual subsidy from the state, and grants and pensions will be assigned to authors, artists and scientific workers, inventions examined and schemes for intellectual advance instituted. Membership will be limited to sixty, the first thirty being nominated by royal decree, on the advice of the president of the council, and the remainder during the next ten years from a list of names preferred by the existing academicians. Academicians will have the privileges of high state officials and will wear a special uniform.

BEGINNING with the January issue, the *American Journal of Psychology* will be conducted by the following board of editors: Professor Margaret F. Washburn, Vassar College; Professor Karl M. Dallenbach, Cornell University; Professor Madison Bentley, University of Illinois, and Professor Edwin G. Boring, Harvard University. Manuscripts offered to the journal may be sent to any member of the board.

UNIVERSITY AND EDUCATIONAL NOTES

THE Tokyo Imperial University has completed plans for the new library donated by the Rockefeller Foundation, and construction work will start in the spring. The structure will be Gothic, three stories high and a basement, with thirty-three acres of floor space and five reading rooms, which will accommodate 2,000.

CONSTRUCTION of a new building for chemistry at the Michigan Agricultural Experiment Station will begin early in the spring, funds for which were granted by the 1924 state legislature.

DR. R. A. PEARSON, president of Iowa State College of Agricultural and Mechanical Arts, has submitted his resignation to take effect next September.

DR. ANDREW GROVER DUMEZ, pharmacologist in the U. S. Hygienic Laboratory, Washington, has been appointed dean of the College of Pharmacy in the University of Maryland.

DR. CHESTER K. WENTWORTH, of the University of Iowa, has been appointed acting associate professor of geology of the University of Virginia to take the place of Albert W. Giles, who recently resigned his position as professor of geology to become head of the department of geology of the University of Arkansas.

DR. LEIGH HOADLEY, Ph. D., '23 (Chicago), has been appointed assistant professor of biology at Brown University and will take up his duties next September. Dr. Hoadley is now studying in Europe.

DR. SEWALL WRIGHT, who for more than ten years has been in charge of animal genetics investigations of the U. S. Bureau of Animal Industry, has been appointed associate professor of zoology at the University of Chicago.

ASSOCIATE PROFESSOR J. W. CAMPBELL, of the University of Alberta, has been promoted to a full professorship of mathematics.

AT the Harvard University School of Public Health, Dr. Joseph Bequaert has been promoted to assistant professor of entomology and Dr. Donald L. Augustine has been promoted to assistant professor of helminthology.

PROFESSOR M. LECHATELIER has resigned the chair of general chemistry at the Sorbonne, Paris, which he has held since 1907. He will be succeeded by M. Job, professor at the National Conservatory of Arts and Metiers.

DISCUSSION AND CORRESPONDENCE

THE PRESENT CONTINUED DEVELOPMENT OF BASAL SHOOTS FROM BLIGHTED CHESTNUT TREES

WITHIN the blight-devastated portion of the range of the American chestnut the frequent appearance of healthy chestnut sprouts from the bases of trees apparently killed by the blight has led to a popular belief that the chestnut is "coming back."

Inoculations by the writer of the roots of some of these sprouts have resulted after one year's time in a very slight growth of the fungus; while the shoots, inoculated at the same time, and from the same pure culture of *Endothia parasitica*, have rapidly been girdled. A full account of this work will be published in a forthcoming number of *Phytopathology*.

Evidently the basal part of the trunk known as the root collar, where root and trunk unite, as well as the tissues of the roots themselves, are partially

resistant to the invasion of Endothia. This is obviously due to some substance or substances present in these regions, which either are not present in the stem tissues or are present in lesser amount. It is possible that these are tannin compounds or perhaps substances closely associated with the occurrence of tannin.

Work recently carried on by the Leather and Paper Laboratory of the Bureau of Chemistry, U. S. Department of Agriculture, shows more than twice as much tannin present in the bark of chestnut roots as in the bark of the trunk. It has been known for some years[1, 2, 3] that tannin or substances closely associated with it, although to some extent utilized by the fungus as food, yet when present in considerable amount, exert an inhibitory effect on its growth.

Whatever the nature of the resistant substance, it is clear that it exists. Ordinarily the fungus does invade the root tissue slowly and the basal shoots die, to be replaced by others as long as any living root collar tissue with adventitious buds remains. Cases are known to the writer where this succession of basal shoots has been going on for more than fifteen years. In the ordinary course of events all signs of life eventually disappear and the tree becomes entirely dead.

However, as sometimes happens in the case of a popular "hunch," the layman may have struck it right. There is surely a possibility that the chestnut may be able to "come back" *via* this route. For if the resistant substances, whatever they may be, should develop somewhat greater concentration, the invasion of the fungus might be successfully checked. In addition, there is always the alternative that the parasite may, in time, lose some of its virulence. Some years ago J. Franklin Collins[4] found a group of chestnut sprouts which, although in 1912 showing attack by the fungus, had apparently succeeded in throwing off the early invasion by 1919. We should be constantly on the lookout for similar cases, for stock of this sort is most valuable in view of the threatened extinction of the species.

ARTHUR HARMOUNT GRAVES
OFFICE OF INVESTIGATIONS IN FOREST PATHOLOGY,
BUREAU OF PLANT INDUSTRY, U. S. D. A.

[1] Clinton, G. P., "Chestnut Bark Disease," Conn. Agr. Exp. Sta. Rept. for *1912*, 359–453, 1913.

[2] Cook, M. T., and J. J. Taubenhaus, "The Relation of Parasitic Fungi to the Contents of the Cells of the Host Plants. I. The Toxicity of Tannin." Del. Coll. Agr. Exp. Sta. Bull., 91, 1911.

[3] Cook, M. T., and G. W. Wilson, "The Influence of the Tannin Content of the Host Plant on Endothia parasitica and Related Species," *Bot. Gaz.*, 60, 346–361, 1915.

[4] Collins, J. F., "Note on Resistance of Chestnut to the Blight," *Phytopath.*, 10, 368–371, 1920.

BACTERIAL LEAFSPOT ON HUBBARD SQUASH

IN August, 1925, leaves of Hubbard squash were received from New York which were thickly covered with angular spots, strongly suggesting the angular leafspot of cucumbers. Bacteria were found in abundance in the spots. Poured plates, however, did not yield anything at all resembling *Bact. lachrymans*. Instead, small yellow colonies predominated on all sets of plates.

Spray inoculations with single colony transfers of this yellow organism have given good infections on Hubbard squash leaves, reisolations have been made from these infections and single colony transfers again proved infectious on squash.

The organism is a gram-negative, polar flagellate rod, commonly with one flagellum. Colonies on thin-sown peptone beef agar, pH 7.0, are visible in three days and after seven days are four mm wide, convex, wax-yellow with internal concentric markings by oblique light. Gelatin is slowly liquefied, nitrates are not reduced; growth is absent or feeble in Cohn's solution and very moderate in Uschinsky's solution. In beef broth a heavy bright yellow rim is formed and often in undisturbed cultures a pellicle, both composed of coarse pseudozoogloeal masses. Litmus milk is peptonized, and a soft curd is formed, but there is no reddening or bluing of the litmus. Later the litmus is completely reduced. Growth on potato cylinders is very abundant, destroying the starch and filling the water with dense yellow slime.

The name *Bacterium cucurbitae* n. sp. is suggested for this organism. Further work is in progress.

MARY K. BRYAN
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

IODINE IN THYROID DEFICIENCY

THE value of iodine as a therapeutic agent for goitrous persons was shown by Dr. David Marine in his extensive experiments on the school children of Akron, Ohio. However, this was not the first use of iodine in this disease in America. J. Young ("Chloroform") Simpson in his treatise on homeopathy (1853) notes the universal employment of seaweed as a remedy for goiter, saying:

> Those suffering from it in South America seem, from medical experience, to have discovered also the uses of matters containing Iodine in the same affection. The stems of a seaweed, and without doubt containing Iodine, have been long chewed by inhabitants of South America under the name of Palo-coto, or Goitre-stick, wherever goitre is prevalent. I am informed by Dr. Greville that Dr. Gillies found this drug carried over the Pampas of Sou'h America, many hundred miles inland, for this

medicinal use. Here we have the same medicinal agent, Iodine, used by people suffering under the same affection in very different and distant parts of the world; and their faith in it founded, no doubt, merely upon their experience of its good effects in the treatment and removal of this disease in those affected by it.

Courtois, a French manufacturer of saltpeter, first isolated iodine in 1812 from the ashes of seaweeds. Although this halogen was itself unknown to the ancients, its therapeutic action was made use of by Roger de Palermo (1180), who recommended the ingestion of seaweeds and sponges as a cure for goiter. Michael Servetus mentioned the value of burnt sponge as a remedy for this condition in Switzerland.

It seems strange that people in different parts of the world, afflicted with enlarged thyroids, should have singled out for use among all the drugs supplied by nature the very one which would prove efficacious, and one wonders how many centuries of trial and error were necessary to confirm the primitive people in their belief in the value of iodine-containing organisms.

ETHEL D. SIMPSON
DEPARTMENT OF PHYSIOLOGY,
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ITHACA, N. Y.

A METEOR FALL

THE Associated Press dispatch of December 16th carries a notice of a meteor which fell at 11 P. M. on Tuesday, December 15, 1925, in a field twenty-four miles southeast of Aberdeen, South Dakota. The press dispatch states that the meteor illumined the landscape with a quivering yellow radiance that changed to bright blue just before the meteor struck the earth.

Correspondence has been published in SCIENCE in the past in regard to the unreliability of personal observations as to the exact location where a meteor fell, and I wish to point out a striking example of this.

At 11 P. M. on Tuesday I was walking along a street in St. Paul on a rise of ground which is very close to the highest point in Ramsey County, Minnesota. Slightly to the north of west I saw a very spectacular meteor fall, and I am convinced that the meteor which I saw fall is the meteor which is noted from Aberdeen, South Dakota. I first noticed it at thirty-five to forty degrees elevation in the western sky and observed it for several seconds before it struck the earth. It had the appearance of a large sky-rocket, excepting in this case it was falling instead of rising, leaving behind it a brilliant path of flame. It appeared to me to fall not more than a quarter of a mile away. As a matter of fact, I hesitated for a moment or more before deciding not to walk over to the place where I thought it fell, and was only deterred from so doing by the fact that no hissing sound accompanied its passage through the air and by the fact that no concussion was heard when it disappeared from sight. The colors were those given in the Associated Press dispatch, a brilliant yellow or orange fading toward the end into a blue.

If the meteor which I saw fall is the one recorded from Aberdeen, South Dakota, it would mean that my estimate of distance of one eighth to one quarter of a mile is an outstanding example of how deceptive one's estimate can be of the location of a meteor fall. In this instance, the meteor fell more than two hundred miles away, but the time, general direction and the color changes are such that I personally believe I saw the fall of the meteor which is recorded in the press dispatch.

R. A. GORTNER
UNIVERSITY OF MINNESOTA

SCIENTIFIC BOOKS

Faune de France. 10. Hyménoptéres vespiformes. 1 (Sphegidae, Pompilidae, Scoliidae, Sapygidae, Mutillidae). By L. BERLAND. Paul Lechevalier, Paris, 1925. (Fr. 45.)

IT would be a fine thing if we could have in the United States something comparable with the *Faune de France,* as projected by a committee of the French Federation of the Natural Science Societies, and as already carried partly into effect. It is the aim of the committee to furnish to naturalists, in convenient form, the means of surely identifying any animal found in France; but not of finding out all that is known about it. The diagnoses are reduced to the essential characters, dichotomous keys, brief bibliographies and abundant text figures are used. Each volume takes up a more or less restricted group, and the introduction to each volume includes such general information about the group as seems necessary.

In general, the distribution of the forms considered covers France, Corsica, Belgium, the Rhine Provinces and western Switzerland. The volumes are well printed, are of usable size and are sold at a cheap price. Twelve volumes of varying prices have already been published, of which six concern groups of insects. I have at hand, in addition to the volume mentioned in the heading, Seguy's "Anthomyidae," Pierre's "Tipulidae" and Chopard's "Orthoptera and Dermaptera," and am greatly impressed with the idea that started the series and with the results as published so far. The United States probably covers too great a territory to make it possible to adopt this admirable plan of the French Federation; but it

would be possible to start a similar series for each of the faunal zones in our territory, to the undoubted delight of all present naturalists, while it would also result in the making of many new students of animal groups.

In the present volume, M. Berland, who is a learned and capable assistant in the great Museum d'Histoire Naturelle at Paris, takes up five families of the fascinating burrowing wasps. Practically all the noted hymenopterists of France have in the past adopted the most praiseworthy habit of donating their collections to the museum of Paris, so that M. Berland had abundant material before him. The wonderful habits of these wasps have been studied with especial zeal by Frenchmen of mark, from Réaumur down to Fabre and Ferton, so that it has been possible for Berland to include with very many of the species brief notes on life history. And in addition to this he gives in his introduction not only a full statement as to habits but presents in tabular form the character of the larval food captured and stored by the adults of the different families and genera. Such a table can not fail to give data on group habits that will be of great comparative value to students of burrowing wasps in all parts of the world. One realizes on glancing at it that on the whole these creatures are undoubtedly of distinct aid to the human species in destroying large numbers of insects that are inimical to our interests.

Although in this very capable introduction Berland shows that he is familiar with the work of the Peckhams on American forms, in the remainder of the volume he seems to ignore the taxonomic conclusions of both American and English authorities. Had I known, when I met him last summer in Paris, that I was to write this little review, I would have quizzed him as to his knowledge of the English-written literature. My learned colleague, Mr. S. A. Rohwer, seems rather exercised that Berland should have used *Ammophila* for *Sphex, Pompilus* for *Psammochares, Elis* for *Campsomeris,* and so on; but in one instance, in a footnote (p. 257), Berland defends his use of *Pompilus* (following the hundred-years-old custom). He adopts the view which even many of the strictest adherents of the rules of the international committee on zoological nomenclature cherish in the back of their minds, that the advantages of holding to the old universally used names *"sont infimes, à côté des perturbations . . . déjà causées dans la nomenclature zoologique."* Dr. Stiles will probably notice this when he reads this number of SCIENCE and will probably labor with me when he sees me next; but, of course, seriously, I am with him and with his international committee.

It must constantly be remembered that this book and the others of the series are primarily handbooks for the identification of the fauna of France, and from this point of view M. Berland has done a most excellent job. Further, he has really gone beyond the handbook idea and has given an admirably condensed summary of all the most important facts known about these most interesting creatures.

An interesting idea suggests itself: Had this excellent book of Berland's been in existence when Fabre was working on these wasps, would the Hermit of Serignan have used it to identify the creatures he was studying in his experimental way? Knowing Fabre's opinion of taxonomists, I fear not; but, according to Ferton and others, it would have been a very good thing if he had.

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The Organization of Life. By SEBA ELDRIDGE. New York: Thomas Y. Crowell Company, 1925. $4.00.

THE merit of "The Organization of Life," by Seba Eldridge, is that in it masses of the data of biology are treated by one whose training and outlook appear not to be biological but logical, philosophical and metaphysical.

The author's main contention is that many of the facts of living nature presented by professional students in this field can not be fully accounted for without recognizing non-physical, non-material factors. In other words, we have here the resources of formal logic and speculative philosophy marshalled in behalf of the vitalistic school of biologists. Thus concerning the origin of variation in organisms we read: "If non-material factors are operative in vital phenomena. . . . It should be possible . . . to provide a metaphysical foundation for our synthetic theory of variations" (p. 53).

This statement fairly typifies, I think, the standpoint from which the book is written. And the work is done with so much industry, good temper, seriousness and technical skill that not biologists alone but scientists in general might profitably read and ponder well every argument presented.

The portions of vital phenomena taken by the author as specially defiant of explanation on the basis of "chemicals and energies" (a couplet much used in the book) are in the realm of variation and heredity. His discussions of adaptation and his defense of neo-Lamarckian theories may be mentioned as particularly instructive in the way just indicated.

But what he has to say about the different types and the weaknesses of prevailing mechanistic and materialistic conceptions is also worth careful study —as is his critical examination of recent vitalistic conceptions, notably those of Bergson, Driesch and Haldane.

One may question whether many biologists will be convinced that the "two specific categories of vital factors, the organizatory and the mental" (p. 394), which the author believes must be recognized, are real in the sense in which he conceives them, can be helpful in researches of the kind they carry on. What help, for example, could any working botanist or anatomist or biochemist get from entelechies (the Drieschian form which Eldridge adopts after subjecting them to rather radical revision) when they are presented to him in this way: "Must not our entelechies, like the chemists, have been limited in the beginning by the incompleteness of their knowledge, a knowledge, however, which has been extended through their efforts to utilize matter?" (p. 426).

This almost sounds as though an embryologist or psychologist, when in the course of a research he comes upon a particular knotty point, might go to his telephone and call in the entelechy that is a specialist in the field where his trouble lies.

But I reiterate that despite the meager value to biology of the positive results reached by Eldridge in this book, he has yet performed an important service to the science if only students in this realm of natural knowledge will take it for what it is essentially, namely, a critical study of certain of the logical processes and philosophical implications necessarily involved in some of the main subdivisions of that realm. For while this is an aspect of biology which can not be escaped finally by biologists themselves, they have so long tried either to ignore it or have treated it so skimpily or lightly that the science is now suffering grievously thereby.

It is good to note that Professor H. S. Jennings, who writes a brief introduction to the book, appraised it in much the same way that we do. So it may be hoped that the work will contribute substantially to putting biology on a broader and more intelligently critical basis than it is now on or ever has been on.

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SPECIAL ARTICLES

SOME PROBLEMS WHICH MAY BE STUDIED BY OXYGENATION

DURING my studies on the effect of oxygen under pressure on protozoa, bacteria, molds and yeasts, I have thought of many problems which might be attacked by means of oxygenation, and, since it is impossible for me to investigate most of them, I have decided to list them, together with brief comments, and pass them on to others for whatever they may be worth. No doubt many of the problems and suggestions when investigated will prove to be of no value whatever, but, I believe, some of them will.

A. PROBLEMS OF IMMEDIATE ECONOMIC IMPORTANCE

(1) *Protozoan parasites of the silkworm and other insects:* It is an important and difficult problem to keep silkworms free of protozoa of the genus *Nosema*. It is quite possible that by confining either eggs or cocoons of the silkworm in oxygen under pressure that this protozoan menace to the silk industry may be entirely got rid of. Similar protozoa occur in other insects; for instance, the honey-bee. They may be killed by oxygenation and without injury to their hosts.

(2) *Protozoan parasites of fishes:* More than three hundred species of microsporidia, one or more species of the flagellate genus *Hexamitus*, species of two ciliate genera, *Ichthyopthirius* and *Chilodon*, and other protozoa, are known to be parasitic on fishes. Some of these protozoa are pathogenic and do damage to fish, causing great losses to the fish industry, and *Ichthyopthirius* produces a disease which makes it a menace to fancy fish dealers and owners. It is known that *Hexamitus* may be killed by oxygenation and without the slightest injury to its hosts. Perhaps the other protozoan parasites of fishes will be killed in the same way.

(3) *Other parasites of fishes:* Trematodes and molds do considerable harm to fish. The ectoparasitic trematode *Gyrodactylus* and the mold *Saprolegnia* would be good examples to begin with in a study of the effect of oxygenation on the trematodes and molds of fishes.

(4) *Protozoa of plants:* Milkweeds harbor many flagellate protozoa of the genus *Herpetomonas*, but the means by which these protozoa are transferred from one plant to another is unknown. Protozoa morphologically identical to those in the milkweeds are found in abundance in the gut of insects (*Oncopeltus*) living on and near the infected plants. It has been impossible so far to determine whether the protozoa in insects and milkweeds are the same organisms or not. The insects may or may not transmit the protozoa from plant to plant. It has been impossible to get suitably uninfected plants and insects with which to carry out experiments.

Of course uninfected plants can be found easily, but such plants may not be susceptible to infection. There are also other difficulties, but by oxygenating plants and insects, thus freeing both hosts of protozoa (as oxygenation will probably do), it seems to me that many if not all difficulties of the problem—Are the protozoa transferred from plant to plant by means of these insects?—would be greatly if not en-

tirely removed; for clean and undoubtedly susceptible plant and animal hosts could thus be obtained.

It has been reported that flagellates producing a disease in plants may, after passage through an invertebrate (insect) and a vertebrate host (lizard), acquire pathogenic properties for a mammal. Oxygenation will perhaps give us uninfected but susceptible hosts to work with, which will enable us to determine beyond question the possible method or methods of infection in nature.

(5) *Insect-transmission of protozoa:* The rôle which many insects are able to play in the transmission of protozoa may very probably be worked out beyond question by confining the insect hosts in oxygen under pressure, because the oxygen, according to many experiments already completed, is much more toxic for protozoa in insects than for the insects themselves. There are a large number of problems which may be attacked by any method which will give us protozoa-free insects to experiment with.

(6) *Virus diseases of plants:* A number of bodies, some of which simulate protozoa in appearance, have been found associated with various plant diseases. The nature of most of these bodies is unknown. If they are protozoa, they should be removed by oxygenating the plants in which they occur. If they can be removed without injury to the plants, it will be possible to determine whether or not they are disease-producing agents. The method of transmission of the disease-producing agent might also be determined.

(7) *Immunity:* Protozoa, and perhaps other organisms, when killed by subjecting them to oxygen under pressure, may be used in the immunization of animals in a manner similar to that in which heat-killed bacteria are used.

(8) *Infested nuts and grain:* By confining insect-infested nuts and grains in oxygen under pressure it is possible to destroy the insects without injury to the nuts and grains. Can this be carried out profitably on a large scale? Can fungus-infested grains be treated in the same manner?

(9) *Sterilization of culture media:* It may be possible by oxygenation to sterilize culture media containing ingredients which can not be sterilized by heat without being greatly changed; if so, certain microorganisms which have not been cultivated on artificial media may be cultivated, and some that have been cultivated with great difficulty may be cultivated more easily.

By oxygenation it may also be possible to sterilize many liquids without changing them greatly, if at all. It may be possible without sterilization to store and preserve liquids under oxygen pressure.

B. PROBLEMS OF GENERAL BIOLOGICAL IMPORTANCE

(1) *The specificity of protozoan parasites:* It is practically certain that all intestinal flagellates and ciliates may be removed by oxygenation from all invertebrates and cold-blooded vertebrates without injury to these animals, and it is possible that other protozoa may be removed from these animals in the same way. If so, it will then be possible by cross infection experiments to determine the host specificity of many closely related and often morphologically indistinguishable protozoa, which hitherto has been impossible because of the lack of a reliable method of obtaining protozoa-free animals to experiment with.

(2) *Partial protozoal defaunation:* The fact that different protozoa in the same host are almost invariably affected differently by oxygenation, that is, have differential death points with a fairly large margin between each point, makes it possible to remove certain kinds of protozoa and then note how this affects those remaining. It will now be possible not only to work out the relation of protozoa to their hosts, but also the relation of the protozoa to each other. How does the presence of one protozoon inhibit the multiplication of another beyond a certain point? There is an inhibition of some kind going on, for, when the inhibiting protozoon is removed, the inhibited protozoon multiplies out of all proportion to what it formerly did.

(3) *The relation of protozoa and other microorganisms to their animal and plant hosts:* The interrelation of host and parasite is an important problem both from the biological and medical standpoint, but it has been little investigated, owing chiefly perhaps to the number of difficulties encountered. For instance, many insects are said to be aided in the digestion of their food by many different kinds of microorganisms, but in most cases we do not know how if at all the microorganisms aid their insect hosts or partners. Many of the so-called examples of symbiosis should be reinvestigated: for instance, zoochlorella and fresh-water animals and zooxanthella and many marine animals (protozoa, sponges, coelenterates, ctenophores, rotifers, bryozoa, turbellaria, annelids, molluscs), insects and intestinal yeasts, insects (Blattidae, Lecaniinae, Coccinae, Aphids, Icerya, Cicada, Aphrophora, Orthezia, Pediculidae, and others) and intracellular yeasts and bacteria, Mycorhiza and various plants, root-nodules and leguminous plants, and, finally, lichens.

Such structures as mycetocytes, bacteriocytes and mycetomes of insects may be the survival of profound pathological changes. If we can learn the origin, function and relation of these structures and